REMR TECHNICAL NOTE CS-ES-3.7

UNDERWATER CLEANING OF CONCRETE AND STEEL: SELF-PROPELLED VEHICLES

PURPOSE: To provide information on self-propelled vehicles for removing marine fouling and corrosion from the submerged portion of concrete and steel structures.

APPLICATION: Self-propelled underwater cleaning vehicles can effectively clean large underwater surfaces prior to inspection, maintenance, and repair operations. Self-propelled vehicles have been used to quickly clean the hulls of Navy ships and commercial oil tankers without dry docking. These vehicles are designed to remove light to moderate fouling from large, accessible underwater surface areas. Although they have been used primarily on steel surfaces, they also can clean concrete.

ADVANTAGES: Cleaning with self-propelled vehicles provides a very fast, effective method of removing fouling and corrosion from underwater structures. Because of their large size, they are less time-consuming than any other underwater cleaning device. Also, these systems will not remove paint or protective coatings from steel surfaces.

LIMITATIONS: Self-propelled vehicles can only be used to clean large, relatively flat and unobstructed areas. The vehicles cannot clean concave surfaces or limited-access areas. The equipment is large and heavy and requires a crane or special deck handling equipment for deployment and recovery. It is also more expensive than other cleaning equipment. There are, however, several diving service companies that use these self-propelled vehicles for underwater cleaning operations.

PERSONNEL REQUIREMENTS: A trained and qualified scuba diver is required to position and monitor the progress of the cleaning vehicle. A crane operator is required to deploy and retrieve the underwater equipment. Depending upon the particular system used, another person may be required to monitor a topside power source or control readouts.

EQUIPMENT DESCRIPTION: An underwater self-propelled vehicle used extensively for cleaning of ship hulls is the SCAMP. This equipment is available from Butterworth Systems, Inc. The SCAMP can be operated by remote control or directly steered by scuba divers. The underwater machine is 6 ft in diameter and 20 in. high (Figure 1). The saucer shaped unit holds three large, rotating brushes and travels on three traction wheels (one of which provides the steering). Various cleaning brushes can be used on the vehicle, depending upon the type and amount of fouling. The cleaning unit makes a 5-ft cleaning swath and can travel up to 90 ft/min depending upon the degree of fouling.

The maximum cleaning rate is therefore 450 sq ft/min. An impeller in a central aperture secures the vehicle to the work surface with a force of 1,000 lb. The machine is connected to a surface control console with a coaxial cable. Power is supplied with a submersible electric motor driving a duplex hydraulic pump.

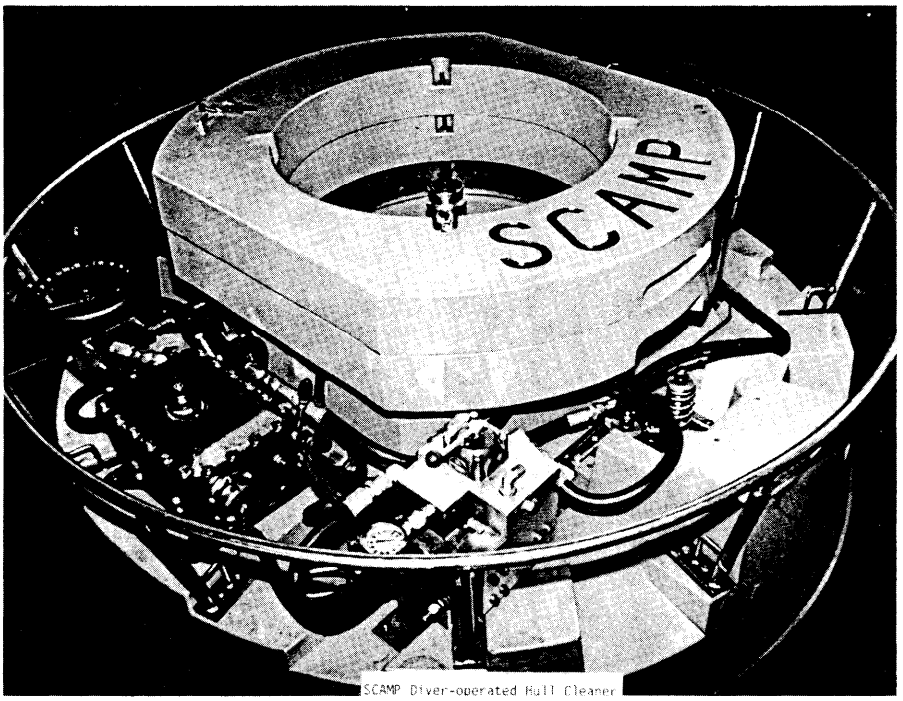

Figure 1. SCAMP self-propelled cleaning vehicle.

Another self-propelled cleaning vehicle designed for underwater hull cleaning is the Brush-Kart by Phosmarine, Marseilles, France (Figures 2 and 3). It is distributed by US Phosmarine, Irvine, CA. This vehicle has three large (16-in.) rotating brushes which can clean a 4-ft-wide strip up to 125 ft/min, yielding a maximum cleaning rate of 450 sq ft/min, depending upon the type and amount of fouling. The vehicle is approximately 6 ft long, 4 ft wide, and 2 ft high. It weighs 360 lb (in the dry), is slightly positively buoyant in water, and is held against the work surface with a 1,400-lb suction force. The vehicle rides on four traction wheels. The front two wheels are driven by a hydraulic motor for forward motion. The hydraulic pump is powered by a 52-horsepower diesel engine. A diver rides the vehicle and directs it with a steering wheel.

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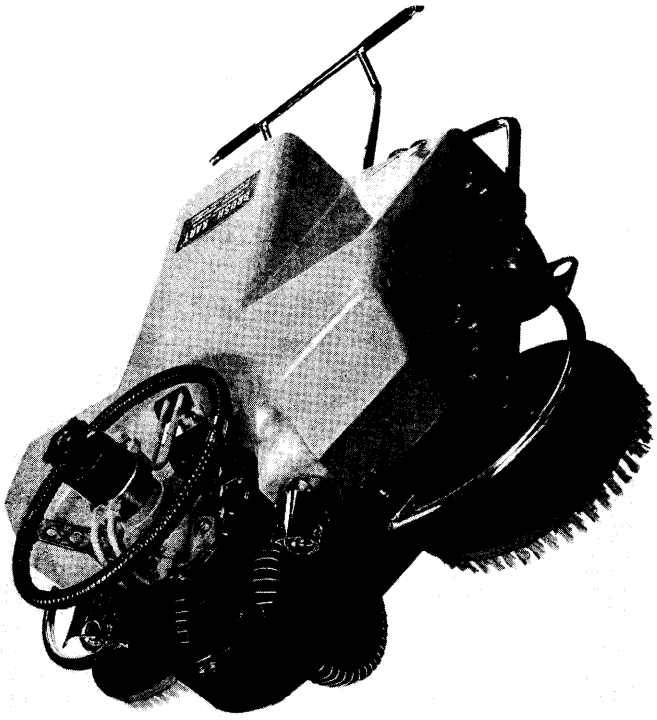

Figure 2. Phosmarine Brush-Kart self-propelled cleaning vehicle.

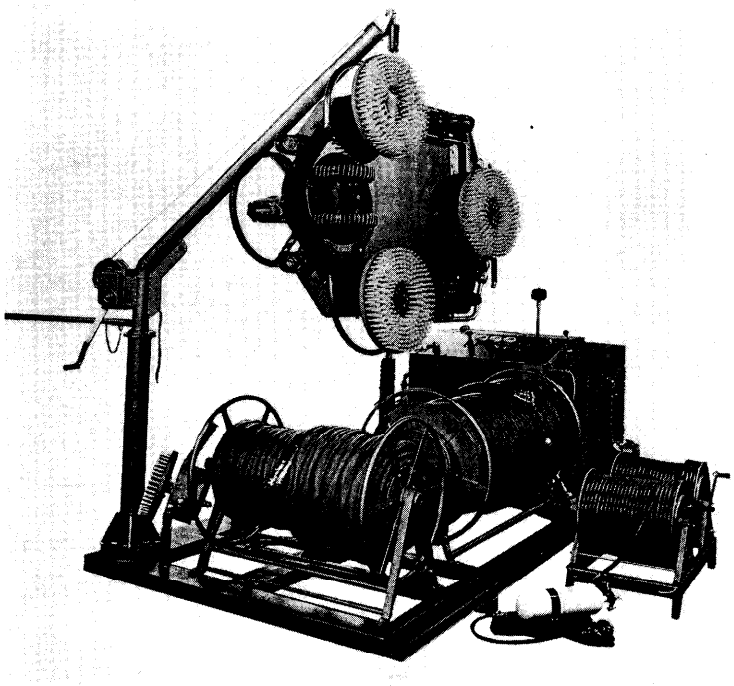

Figure 3. Brush-Kart cleaning system.

ENVIRONMENTAL CONSIDERATIONS: Cleaning operations with the equipment discussed in this Technical Note may increase the level of suspended and soluble materials in the water column adjacent to and downstream from the operation. Whether these increases will result in unacceptable water quality or other undesirable environmental consequences should be evaluated on a project-specific basis. Variables that influence the nature and magnitude of any impacts include, but may not be limited to: the hydrodynamic setting, the physical and chemical characteristics of the sediment or residue generated during the cleaning or dredging process, and the regulatory environment. Personnel familiar with evaluating water quality impacts of construction operations should be consulted during the early stages of project planning to ensure that appropriate water quality criteria and other environmental regulations will be met.

REFERENCES: Procedures and devices for underwater cleaning of civil works structures. C. A. Keeney, Naval Civil Engineering Laboratory, Port Hueneme, CA. Prepared for US Army Engineer Waterways Experiment Station, Vicksburg, MS. Technical Report REMR-CS-8 (in preparation).